

Hydrodynamic instability experiments on the Nova laser*

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Hydrodynamic instabilities are ubiquitous in nature, occurring in inertial confinement fusion, astrophysics, and other applications of high energy-density physics. We are examining the effects on Rayleigh-Taylor (RT) and Richtmyer-Meshkov (RM) instability growth under a variety of conditions including 2D versus 3D perturbation shape,¹ at an ablation front versus at an embedded interface,² multimode versus single mode,³ planar versus convergent geometry,^{4,5} and solid versus liquid state.^{4,6,7}

Our planar versus convergent geometry comparison uses both 2D and 3D single mode perturbations.^{4,5} The convergent experiments use face-on radiography of imploding hemispheres mounted on the side of a hohlraum. In separate shots, planar packages with identical perturbations are also mounted on the wall of an otherwise identical hohlraum, to isolate the effects of convergence. Other experiments probe the RT instability evolution at an embedded interface remote from the ablation front. In the absence of ablative stabilization, short wavelength modes grow strongly. We have previously examined growth of single modes over a wavelength span of 10-100 μm .² We are now examining the growth of two superposed modes, using mode coupling to infer strong growth of wavelengths as short as 4-5 μm . The goal is to ultimately observe bubble merger and measure the two-bubble merger rate. In a similar embedded interface RT experiment, we have developed a "nearly adiabatic" shaped x-ray drive that compresses metal foils by factors of 1.5-2.0 at pressures of 3-5 Mbar, but at temperatures at or below the melt point.^{4,6,7} We observe inhibited RT growth during the time that the foils are under compression, and interpret our results using simulations and a theoretical solid-state RT dispersion curve analysis.⁷ Motivated by questions regarding RM-RT evolution in core-collapse supernovae (SN), we have also started an experiment with the Astronomy and Physics Departments of the University of Arizona to investigate the hydrodynamic instability evolution in a scaled experiment simulating the He-H "interface" of a Type II SN. We model the experiment using supernova hydrodynamics codes.⁸

An overview of our hydrodynamics work on the Nova laser will be given.

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